APPENDIX C. SEQUOIA CREEK SURVEY

Watershed: LOWER SEQUOIA CREEK

Date: April 28 and 29, 1998

Location: Highland Drive to 9th Street

Observations: This segment of Sequoia Creek in the Corvallis lowlands is completely channelized and undoubtedly bears little relationship to the original Sequoia Creek drainageway. The channel appears as a straight-line ditch that is formed in cohesive silt/clay material, is entrenched approximately 1.8 to 2.4 meters (6 to 8 feet) below the regional grade, and has a very low gradient. Low-flow channel width varies from approximately .9 meter (3 feet) (where low depositional flood benches are present) to 3.7 meters (12 feet). The streambed consists of silt or fine sandy sediment, with occasional very loose, deep deposits of this material. Occasional channel-blocking accumulations of man-made debris (tires, lumber, etc.) and smaller woody debris also are in the low-flow channel. Banks are generally stable and in most places are covered with weedy grasses, forbs, or blackberry (*Rubus discolor*) thickets. The woody vegetation canopy is interrupted in places, but trees or shrubs generally grow on at least one bank over most of the length of the corridor. Trees and large shrubs range from seedlings to mature individuals of cottonwood (*Populus balsamifera*), willow (*Salix* sp.), alder (*Alnus* sp.), hawthorn (*Crataegus* sp.), cherry (*Prunus* sp.), and occasional ornamentals such as exotic conifers.

At Bruce Moser's request, a SHAPIRO soil scientist looked for a pipe outfall on the left (north) bank that appears on City maps generally in line with Fairlawn Street. The scientist was unable to locate this outfall because a blackberry thicket covered the bank in this vicinity. However, no evidence of a functional outfall in this vicinity, such as a locally eroded bank, was observed.

A major pipe feeds into Sequoia Creek on the left bank about 45.7 meters (150 feet) east of Fairlawn Street (and just west of the Trinity Missionary Church). The outlet consists of a broad concrete arch, the roof of which is approximately 1.4 meters (4.5 feet) above the streambed, which consists of silt and fine sand. Channel invert width is about 4.5 meters (15 feet). The homeowner immediately upstream is concerned for the safety of small children who walk along the top of this outlet structure. The structure is crossed by a fence, which leaves only a narrow edge on which to walk. The hinged steel grate gate on the structure was found open during the April 28 field visit.

Because the stream is extensively piped upstream from this area and goes dry in the summer, it is SHAPIRO's opinion that instream habitat conditions (which are very poor) should not greatly influence channel management decisions with respect to flood relief on this segment of the creek. In discussion with SHAPIRO's soil scientist in March 2001, Gary Galovich of the Oregon Department of Fish and Wildlife (and a member of the SWPC) suggested that the ODFW would likely concur that this system has low rehabilitation potential with respect to fishes, especially salmonids.

The City has indicated that this segment of the creek is extremely prone to flooding. The City would like to see some work toward rehabilitation performed here this year. SHAPIRO agrees and believes the stream corridor environment in this reach can be benefited by an appropriate flood improvement project in this area.

Recommendations: The obvious approach to improving flood conveyance here is to enlarge the floodway cross-section, as was done last year on Dixon Creek. Backyard fences closely encroach on the stream corridor, leaving an “average” corridor width on the order of 9.1 to 12.2 meters (30 to 40 feet). However, the backyards of the residences along the creek are generally fairly deep, so a segment of these properties could be appropriated without completely eliminating the backyards, assuming the residents are willing participants.

Wherever feasible, SHAPIRO’s soil scientist suggests regrading bank slopes to a lower angle than was possible on Dixon Creek. This should increase groundcover and tree planting success and minimize the risk of future localized slope failures. A number of the properties, especially those that front on Sycamore Avenue, have very deep backyards, so this may be possible in much of the area.

It would be useful to maintain or construct a narrow low-flow channel (.9 to 1.2 meters [3 to 4 feet] wide or so) to assist in temperature modulation and the improvement of (at least seasonally-available) aquatic habitat. This can be done by preserving existing depositional flood benches and creating new flood benches when cutting back the banks, as was done on Dixon Creek. As an optional treatment, in areas where the channel has a wide, “flat” floor, low channel-pinching benches could be constructed by creating a stable perimeter of large rock or coconut-fiber logs, backfilling these structures, then stabilizing these surfaces with seed and matting or pre-grown turves (sod mats). Areas of excess fine sediment accumulation, such as upstream from small debris jams and in the vicinity of the major pipe outlet near Trinity Missionary Church, should be cleaned out as part of the channel rehabilitation work.

If there is interest in it, bank regrading and (possible) low-flow channel reconstruction could be conducted in a manner that disguises the straightness of the channel. Making the new bank slope contours sinuous and shifting the low-flow channel from side to side with flood benches (constructed or preserved) would impart a more natural appearance to the channel and improve the aesthetics of this reach. On the other hand, this is not a public access area and may not need this extra effort.

Beneficial trees growing along the upper portion of the bank (south bank in particular) might be retained wherever feasible so as not to completely eliminate the shade canopy from the creek corridor. If this option is chosen, hand-stacked stone retaining walls or riprap can be placed adjacent to preserved trees where slopes cannot be laid back. SHAPIRO has applied this technique with success on several projects.

As recommended for Dixon Creek, aggressive tree planting should be applied to upper regraded bank slopes and the top-of-bank, leaving the lower bank open for conveyance purposes. Trees should be preferentially planted on the south bank if budget is limited. Recommended species include, but are not necessarily limited to, alder, Oregon ash (*Fraxinus latifolia*), big-leaf maple

(*Acer macrophyllum*), and white oak (*Quercus alba*). Cottonwood seedlings and saplings growing within the low-flow channel should be eliminated, as they will eventually interfere with flow conveyance.

Finally, it might be useful to construct sediment traps or forebays where major pipes outlet to the open channel of Sequoia Creek (i.e. Highland Drive and the major left bank outlet situated just downstream from Fairlawn Street). These could be constructed for periodic easy cleanout by heavy machinery.

Stewardship Opportunities: Tree planting and maintenance would be necessary to ensure successful plant establishment. Community volunteers could be involved in this activity.

Location: 9th Street to Highway 99W

Observations: A large quantity of fine sediment has accumulated in the three box culverts under 9th Street. The straight reach between 9th Street and Highway 99W is hemmed in by commercial parking lots and has a highly simplified cross section with a 3.7-meter- (12-foot-) wide silt-floored streambed and steep (1:1) bank slopes. Conveyance is not hindered through this reach but curb-to-curb stream corridor width is only about 9.1 meters (30 feet). Moreover, flow conveyance is retarded by the sharp left bend taken by the channel when it reaches the vicinity of Highway 99W, as well as by the double channel configuration (with intervening soil berm) of the segment extending north along the highway, downstream from this tight bend.

Recommendations: Clean out the sediment under and in the vicinity of the 9th Street crossing. Conveyance through the straight reach between the two roads could be enhanced if the corridor width could be enlarged, allowing bank slopes to be re-profiled to a lower angle. Alternatively, retaining walls and a low flood bench could be constructed to create an enlarged cross section within the existing stream corridor width, although this would probably be expensive and might not be necessary if other potential flood conveyance improvements are implemented. It would have the advantage, however, of being a highly visible improvement. (Also, it would be a chance to demonstrate that there are “hard” or “engineered” but still environmentally sensitive stream corridor rehabilitation treatments appropriate to, and often necessary in, highly urbanized environments. A “bioengineering” approach is not realistic on many urban stream segments.) The ornamental shrub hedge on the right bank could be replaced with native trees and shrubs for improved shade and some degree of “re-naturalization.”

The double-channeled segment of Sequoia Creek paralleling Highway 99W should be rehabilitated by eliminating one of the channels and removing the high, steep soil berm between the two channels. Material from the berm can be used to fill the redundant channel. A broad, low flood bench and increased flood channel conveyance capacity would thereby be created. Extensive tree plantings on both sides of the channel would shade the channel and flood bench, eventually reducing flow-retarding grass and shrub growth in the lower floodway cross section. As an added measure, the right bank at the tight bend, where the creek turns north along the highway, could potentially be excavated into an “alcove” which would promote sedimentation in this area. This could be easily accessed for periodic cleanout from the shoulder of the highway.

Stewardship Opportunities: Tree planting and maintenance would be necessary to ensure successful plant establishment. Community volunteers could accomplish these tasks.

Location: Highway 99W to railroad crossings

Observations: Several factors contribute to upstream backwater effects. These include the tight right bend at the inlet to the highway culverts, the smaller capacity of the twin box culverts here (as compared to 9th Street), the offset channel (abrupt jog left) in the narrow area between the highway and railroad crossings (and complex hydraulics here), and the relatively small span of the railroad bridge itself. This is a quintessential situation limiting urban stream rehabilitation for flood relief or anything else.

The twin box culverts under Highway 99W were <u>both dry</u> when visited on April 28. Creek flow was instead discharging from a partly silted-in .91-meter (36-inch) concrete culvert set at a lower grade than the box culverts. The outlet of this culvert was about .3 meter (10 feet) north of the left box culvert. The hardened invert under the railroad bridge forms a backwater pool that partly drowns this low-flow culvert, enhancing sediment deposition in it. Someone has placed a picnic table in the left box culvert at its upper end. This obviously could become a major conveyance issue, especially as the table racks up additional flood debris during a high-flow event.

Recommendations: Remove the picnic table from the box culvert under Highway 99W. Beyond this, a major engineering effort would obviously be required to improve conveyance through this reach

Location: Railroad Bridge to Belvue Street Crossing

Observations: The channel downstream from the railroad bridge to the Belvue Street crossing borders the Corvallis Recycling Center, which closely encroaches on the left (north) bank. The right (south) bank is tree-lined, providing good shade for suppressing in-channel vegetation growth. While the right bank is encroached upon by a trailer park at the east end of this reach, this bank is quite stable, being covered with ivy (*Hedera helix*). Low-flow channel width varies from .9 to 4.3 meters (3 to 14 feet) or so, but even the narrow section is constrained by low depositional flood benches: the overall trapezoidal cross section is essentially uninterrupted, providing relatively good conveyance (for this creek). Average channel width through the reach is approximately 3 to 3.7 meters (10 to 12 feet) and the channel is entrenched about 1.8 to 2.4 meters (6 to 8 feet) below grade.

Immediately upstream from the Belvue Street crossing (which consists of three box culverts), substantial fine sediment has accumulated. This is in the form of a large marginal bar along the left bank, which is now stabilized by herbaceous growth (mainly reed canarygrass [*Phalaris arundinacea*), as well as loose, soft sediment in the low-flow channel itself. Plastic trash has blown into the creek corridor from the east portion of the Recycling Center, which consists of a large parking/operations area.

Recommendations: since infrastructure encroaches closely on the channel in the upstream portion of this reach, excavating the right bank could increase conveyance. However, this would require removal of the native riparian woodland here. In order not to eliminate this woody vegetation, a better choice for enhancing conveyance would be the installation of a steep retaining wall in place of the existing _1:1 slope on the left bank. This is another example of a "hard" channel rehabilitation approach perhaps being the most environmentally sensitive strategy since this would preserve the right bank area of streamside woodland.

Along the downstream half of this reach, the trailer court along the right bank closely encroaches on the stream channel. The Recycling Center's asphalt parking/operations area borders the channel on the left bank. A strip of this area potentially could be taken to allow bank regrading to enlarge the flood channel cross section, thereby preserving the dense tree cover on the right bank. Alternatively, a retaining wall or steep riprap treatment could be placed on this bank.

It would be helpful to require that the Recycling Center place a fence along its property perimeter to help keep trash out of the creek.

Stewardship Opportunities: Tree planting and maintenance to would be necessary to ensure successful plant establishment (if any bank work is pursued). Clean up plastic trash in the creek. (Note: This clean-up effort would be somewhat futile if the Recycling Center is not required to fence off its operations area from the creek, since this appears to be the major source of the trash.)

Location: Belvue Street to Jack London Street

Observations: The stream corridor segment between Belvue Street and the newly-constructed Jack London Street crossing consists of a relatively high-quality riparian woodland of willow, ash, cottonwood, alder, hawthorn, and other native species in the subcanopy vegetative layers (but including blackberry, especially along the edges). This mix of vegetation produces a nearly impenetrable thicket. The woodland also contains substantial downed woody debris, although this is mostly smaller material. Channel banks are 1.2 to 1.8 meters (4 to 6 feet) high, stable, and comprised of silt and clay. Average channel width is on the order of 2.4 meters (8 feet) and stream gradient is very flat. Lower average channel width results in some sections of relatively deep water (more than .3 meter [1 foot]) in this reach. Raccoon tracks were first noticed in this better quality habitat area.

The streambed in this reach consists mainly of silt and very fine sand. Immediately downstream from Belvue Street is an especially deep and soft in-channel sediment accumulation where a dense willow thicket closely encroaches on the channel. The multiple low branches of these plants tend to trap additional floating debris, thereby impeding the flow. Flow expansion after the culverts, along with the dense willow growth, evidently have produced a stilling effect here, causing extra sediment deposition. The channel-crowding growth of willow in this area demonstrates the potential detrimental effects of using willow plantings along narrow and unmaintained urban stream channels where flow conveyance and flood risk are issues.

Recommendations: Maintain this patch of relatively wide stream corridor to the extent feasible. This area serves as a model of the kind of buffer width that would be desirable to maintain along urban streams generally. For improved conveyance through this reach, excavate the excess sediment that has accumulated immediately downstream from Belvue Street and selectively prune the dense willow growth here.

If substantially improved conveyance is required through this reach, a broad, low flood bench could be created along the left (north) bank. This would necessitate the removal of some woody vegetation but would preserve the generally wooded character of the corridor as well as the shade-producing canopy on the south side of the stream. The constructed flood bench could actually diversify habitat conditions in this reach, especially if native herbaceous wetland vegetation is planted on the bench. Native shade-tolerant wetland species, such as certain varieties of sedge (*Carex* spp.), are appropriate for this setting.

Stewardship Opportunities: With supervision, community volunteers could (selectively) prune the willow growth at the upstream end of the reach. They also could plant wetland species on the constructed flood bench if this option is pursued.

Location: Jack London Street to railroad right-of-way/Conser Street

Observations: This stretch of stream corridor resembles the upstream reach, except that it recently has been encroached upon by new light industrial facilities. As a result, the wooded stream corridor width is now on the order of 15.2 to 22.9 meters (50 to 75 feet) wide. The edges have been disturbed in many areas, promoting blackberry establishment.

The crossing at Jack London Street is newly installed; this has resulted in a de-vegetated left streambank (now covered with an erosion-control blanket) and a thick accumulation of fine sediment immediately downstream from the box culverts. Not far downstream from this area, two large (for this channel) debris jams span the channel. The backwater thus created has enhanced sedimentation.

The fill forming an old stream crossing approximately 106.7 meters (350 feet) upstream from the railroad tracks appears to have been surfaced with asphalt and is now partly overgrown with grass. A 2.1-meter- (7-foot-) diameter CM pipe that is filled to approximately half its diameter with large quarried rock and silt (or is actually an arch culvert) pierces the fill.

Recommendations: Plant woody streamside plants on the disturbed left bank adjacent to Jack London Street (small shrubs and low trees along the upper bank). Remove excess sediment from the channel. Remove the existing debris jams in this reach and selectively prune lower bank-side woody vegetation to reduce the tendency for future debris jams. Remove the old culverted stream crossing–this forms an unnecessary pinch point in the channel.

Stewardship Opportunities: Community volunteers could perform several tasks in this reach, including (supervised) **s**elective pruning of woody lower bank vegetation, removal of the debris jams, replanting of the bank areas that have been disturbed by construction and by removal of the old crossing, and maintenance of the plantings until they are established.